

PRELIMINARY DATA SUMMARY

JUNE 1990

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

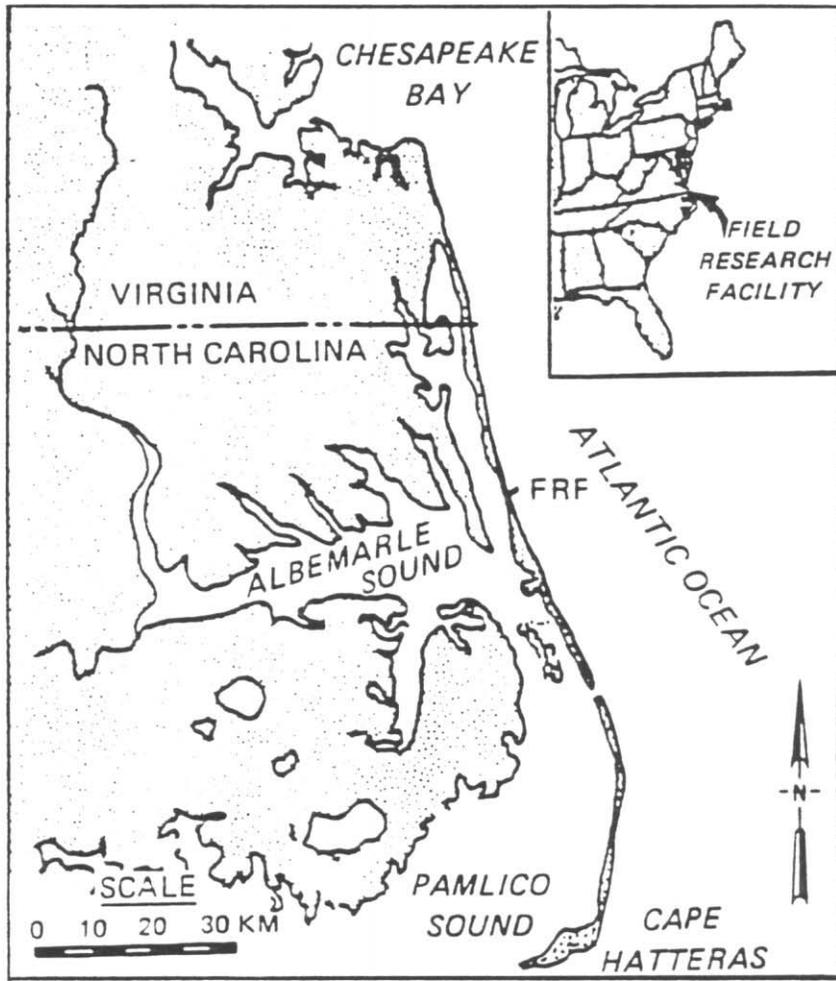


Figure 1. FRF location map



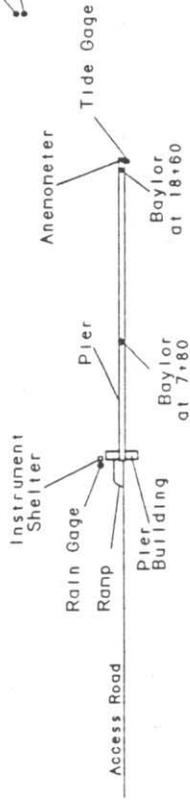
True North



Current Meter  
320 n north of pier  
Pressure Gage  
309 n north of pier

Offshore  
Waverider Buoy  
(No. 630)

Pier Building at 0+40 to 1+00  
Anemometer at 0+70  
12 Inch Rain Gage at 0+30  
Instrument Shelter at 0+40



CURRITUCK SOUND

ATLANTIC OCEAN

Offshore  
Waverider Buoy  
(No. 630)

Baylor Gage (No. 645)  
at 7+80

Pier Deck 7.6 n  
Baylor Gage (No. 625) at 18+60

Pier Building  
Instrument Shelter  
Rain Gage

Anemometer 19n (No. 932)  
Tide Gage (No. 865-1370) at 19+60

Elevation (ft)  
20  
15  
10  
5  
0  
-5  
-10  
-15  
-20  
-25

Elevation (m)  
6  
4  
3  
0  
-3  
-6  
-9  
-12  
-15  
-18  
-21  
-24  
-27

Station Number (hundreds of feet)  
-600 -400 -200 0 200 400 600 800 1000 1200 1400 1600 1800 2000

Pressure Gage (No. 111) north of pier  
Current Meter (No. 519) north of pier

Baylor Gage (No. 645) at 7+80  
Pier Deck 7.6 n  
Baylor Gage (No. 625) at 18+60  
Anemometer 19n (No. 932)  
Tide Gage (No. 865-1370) at 19+60  
Current Meter (No. 519) north of pier  
Pressure Gage (No. 111) north of pier

Station Number (hundreds of feet)  
-600 -400 -200 0 200 400 600 800 1000 1200 1400 1600 1800 2000

Distance (meters)  
-600 -400 -200 0 200 400 600 800 1000 1200 1400 1600 1800 2000

Station Number (hundreds of feet)  
-600 -400 -200 0 200 400 600 800 1000 1200 1400 1600 1800 2000

Distance (meters)  
-600 -400 -200 0 200 400 600 800 1000 1200 1400 1600 1800 2000

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Distance (meters)  
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Distance (meters)  
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Station Number (hundreds of feet)  
-600 -400 -200 0 200 400 600 800 1000 1200 1400 1600 1800 2000

Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

## PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -  
 $\text{mm} \times .03937 = \text{in.}$
2. Millibars (mb) to inches of mercury (in. Hg) -  
 $\text{mb} \times 0.02953 = \text{in. Hg}$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -  
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -  
 $\text{m/s} \times 1.943 = \text{kn}$

Table 2: Meteorological Data

Jun 1990

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed	Direction	deg C	Pressure	mm
		m/sec	deg TN		mb	
1	100	4	110	17.1	1021.3	0
	700	3	127	19.6	1023.3	0
	1300	5	126	23.3	1023.6	0
	1900	6	201	22.3	1022.3	0
2	100	6	223	20.8	1023.3	0
	700	5	239	22.2	1024.7	0
	1300	7	197	25.8	1023.0	0
	1900	8	183	22.7	1020.9	0
3	100	5	201	21.1	1019.6	0
	700	7	204	22.6	1018.2	0
	1300	10	219	27.2	1014.5	0
	1900	13	197	23.7	1010.1	0
4	100	8	210	23.4	1009.1	0
	700	8	229	24.0	1008.1	0
	1300	5	246	28.5	1006.0	0
	1900	11	5	18.8	1008.1	0
5	100	9	353	16.9	1010.8	0
	700	10	18	16.7	1014.2	0
	1300	5	25	17.3	1016.2	0
	1900	4	90	15.8	1016.5	0
6	100	5	130	16.4	1017.9	0
	700	3	144	20.1	1019.2	0
	1300	8	142	23.7	1017.2	0
	1900	9	188	22.3	1015.5	0
7	100	10	217	22.2	1015.2	0
	700	8	237	23.5	1015.5	0
	1300	7	245	29.4	1013.5	0
	1900	2	109	22.5	1014.2	0
8	100	3	138	22.7	1016.5	0
	700	4	73	23.1	1016.9	0
	1300	7	139	26.3	1016.5	0
	1900	7	180	25.7	1014.5	0
9	100	10	231	25.1	1014.5	0
	700	9	237	25.3	1014.2	0
	1300	6	256	30.6	1013.1	0
	1900	10	215	28.0	1010.8	0
10	100	8	233	25.6	1011.4	0
	700	7	259	24.9	1011.1	0
	1300	7	233	29.6	1009.1	0
	1900	7	33	21.0	1008.4	0
11	100	9	344	21.3	1008.7	0
	700	10	349	20.9	1010.8	0
	1300	6	9	21.0	1010.8	0
	1900	8	9	21.0	1011.4	0
12	100	13	1	18.0	1013.5	0
	700	10	15	17.8	1016.9	0
	1300	12	354	21.7	1018.2	0
	1900	9	40	19.1	1018.6	0
13	100	4	20	18.1	1018.6	0
	700	6	334	19.2	1019.6	0
	1300	6	27	20.4	1019.2	0
	1900	5	74	18.6	1017.2	0
14	100	1	113	18.3	1015.5	0
	700	3	277	20.0	1014.8	0
	1300		*	22.5	1013.5	0
	1900		System down for repair			0
15	100		*	19.4	1010.1	0
	700		*	19.3	1010.8	0
	1300	6	77	19.3	1011.4	0
	1900	7	44	18.5	1012.8	0
16	100	4	60	16.8	1013.5	0
	700	6	18	17.3	1015.2	0
	1300	7	22	19.1	1016.2	0
	1900	3	39	18.0	1016.5	0

\* electronic problems

(Continued)



### PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height  $H_{mo}$  is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period  $T_p$  is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all  $H_{mo}$  and  $T_p$  values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Jun 1990

Day	Hour	645		625		111		630	
		Baylor at 7+80 Hmo.m	T.sec	Baylor at 18+60 Hmo.m	T.sec	Pressure Gage Hmo.m	T.sec	Offshtr Wvrdr Hmo.m	T.sec
1	0100	0.47	15.06	0.68	15.06	0.72	8.26	0.80	15.06
	0700	0.43	15.06	0.65	15.06	0.67	15.06	0.71	8.83
	1300	0.38	15.06	0.58	8.26	0.69	8.26	0.69	8.83
	1900	0.36	15.06	0.57	15.06	0.58	8.00	0.60	7.76
2	0100	0.29	15.06	0.51	14.22	0.53	8.26	0.57	7.76
	0700	0.29	15.06	0.47	8.00	0.53	14.22	0.53	8.00
	1300	0.27	14.22	0.44	14.22	0.46	14.22	0.57	7.76
	1900	0.30	14.22	0.43	14.22	0.41	12.80	0.53	8.26
3	0100	0.28	14.22	0.38	14.22	0.44	14.22	0.49	14.22
	0700	0.28	14.22	0.40	13.47	0.44	13.47	0.48	8.00
	1300	0.33	13.47	0.45	13.47	0.46	12.80	0.67	3.61
	1900	0.45	3.82	0.53	8.83	0.53	8.26	0.87	4.41
4	0100	0.41	6.09	0.54	8.53	0.57	8.83	0.72	5.69
	0700	0.43	5.69	0.59	8.26	0.62	8.83	0.79	5.95
	1300	0.45	5.69	0.61	6.40	0.73	6.56	0.82	6.74
	1900	0.70	3.51	0.84	3.82	0.90	3.66	1.08	3.82
5	0100	1.31	5.02	1.15	5.12	1.23	5.12	1.36	5.02
	0700	1.20	5.33	1.10	5.33	1.26	5.45	1.39	5.33
	1300	1.04	5.95	0.97	6.09	1.05	6.24	1.41	5.95
	1900	0.73	5.69	0.70	6.56	0.87	6.24	0.81	6.74
6	0100	0.61	6.40	0.71	6.74	0.72	6.92	0.76	6.56
	0700	0.45	5.57	0.66	8.26	0.73	8.26	0.74	8.00
	1300	0.47	7.31	0.70	7.76	0.70	8.00	0.79	8.26
	1900	0.36	9.85	0.54	9.48	0.58	7.53	0.71	8.00
7	0100	0.32	8.53	0.45	9.14	0.45	8.53	0.58	8.83
	0700	0.26	8.83	0.41	8.26	0.45	9.14	0.53	8.83
	1300	0.27	8.53	0.39	8.53	0.44	9.14	0.48	8.00
	1900	0.30	8.26	0.38	8.26	0.47	8.83	0.52	7.76
8	0100	0.26	9.14	0.40	8.53	0.40	8.26	0.44	8.83
	0700	0.22	8.53	0.33	8.53	0.38	8.53	0.41	8.53
	1300	0.30	8.83	0.40	8.83	0.35	8.00	0.44	8.00
	1900	0.24	8.53	0.32	8.53	0.36	8.83	0.43	8.53
9	0100	0.21	8.53	0.29	8.83	0.28	8.53	0.56	2.64
	0700	0.17	8.83	0.26	8.00	0.31	8.83	0.36	8.00
	1300	0.19	8.83	0.30	8.26	0.28	8.53	0.38	8.00
	1900	0.26	4.06	0.30	7.76	0.33	6.92	0.54	4.66
10	0100	0.21	7.11	0.27	8.53	0.29	7.11	0.39	7.53
	0700	0.44	4.83	0.47	4.83	0.51	4.49	0.66	4.57
	1300	0.28	4.66	0.35	9.48	0.36	8.00	0.46	6.24
	1900	0.22	8.53	0.28	8.00	0.31	9.14	0.42	7.53
11	0100	0.27	4.49	0.32	9.14	0.32	9.14	0.44	9.14
	0700	0.59	5.22	0.63	5.12	0.79	4.83	1.32	4.83
	1300	0.68	5.33	0.61	5.02	0.67	4.92	1.20	5.12
	1900	0.57	5.22	0.54	4.83	0.62	4.83	1.16	5.02
12	0100	1.61	6.40	1.35	6.40	1.51	6.24	2.12	6.24
	0700	1.70	6.92	1.50	6.56	1.75	6.56	1.65	6.56
	1300	1.52	8.00	1.50	8.00	1.60	7.76	1.69	8.00
	1900	1.30	7.53	1.60	8.53	1.69	7.53	1.55	8.00
13	0100	1.39	9.14	1.70	9.85	1.91	9.85	1.89	9.14
	0700	1.38	9.85	1.73	10.67	1.62	8.83	1.63	11.13
	1300	1.38	12.80	1.97	12.80	2.01	12.80	1.95	12.19
	1900	1.22	11.13	1.70	10.67	2.00	12.19	1.98	12.80
14	0100	1.19	12.19	1.71	12.19	1.85	12.19	1.75	12.19
	0700	1.39	12.80	1.76	12.19	1.88	12.80	1.84	12.19
	1300	0.96	13.47	1.63	12.80	1.69	12.80	1.57	12.80
	1900								
15	0100	0.57	9.85	1.09	10.24	1.11	9.85	1.09	8.53
	0700	0.76	9.48	1.16	9.48	1.11	9.85	1.16	9.85
	1300	0.61	9.48	0.94	9.14	1.07	9.14	1.09	9.48
	1900	0.69	9.14	0.96	8.83	0.98	9.14	1.00	8.83
16	0100	0.55	8.83	0.85	9.14	0.98	9.14	1.05	8.26
	0700	0.61	9.48	0.85	9.14	0.88	9.14	0.93	8.53
	1300	0.57	9.14	0.83	9.48	0.92	9.48	0.96	9.14
	1900	0.58	8.83	0.82	8.83	0.93	9.14	0.93	9.14

\* Electronic problems

(Continued)

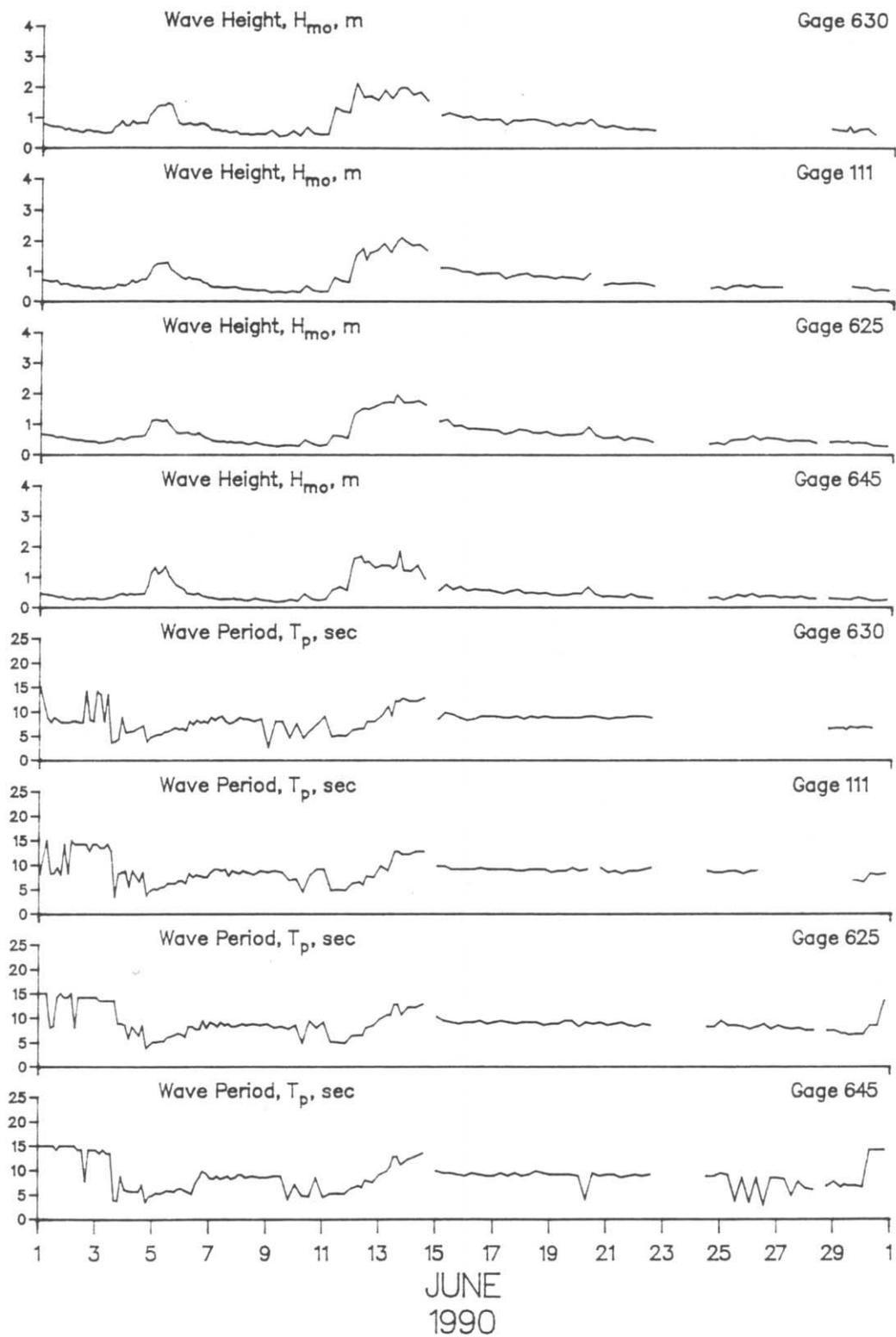
Table 3: Wave Data

Jun 1990

Day	Hour	645		625		111		630	
		Baylor at 7+80 Hmo.m	T.sec	Baylor at 18+60 Hmo.m	T.sec	Pressure Gage Hmo.m	T.sec	Offshtr Wvrdr Hmo.m	T.sec
17	0100	0.52	8.83	0.80	9.14	0.93	9.14	0.95	9.14
	0700	0.46	9.48	0.67	9.48	0.76	9.14	0.77	8.83
	1300	0.55	8.83	0.73	9.14	0.83	9.14	0.91	8.83
	1900	0.60	9.48	0.83	8.83	0.89	8.83	0.91	9.14
18	0100	0.48	8.83	0.81	9.14	0.93	8.83	0.94	8.53
	0700	0.50	9.14	0.73	9.14	0.82	9.14	0.95	9.14
	1300	0.47	9.85	0.71	9.14	0.83	9.14	0.89	8.83
	1900	0.49	9.48	0.76	8.53	0.81	9.14	0.84	9.14
19	0100	0.41	9.14	0.66	8.83	0.75	8.53	0.73	8.83
	0700	0.40	9.14	0.62	8.83	0.82	8.83	0.81	8.83
	1300	0.41	9.14	0.65	9.48	0.79	8.83	0.72	8.83
	1900	0.47	9.14	0.65	9.48	0.78	9.48	0.82	8.83
20	0100	0.47	8.83	0.70	8.26	0.72	8.83	0.80	8.83
	0700	0.68	4.00	0.90	9.14	0.91	9.14	0.95	9.14
	1300	0.44	9.48	0.63	8.83	*		0.74	9.14
	1900	0.35	8.83	0.54	9.14	0.55	9.48	0.66	8.83
21	0100	0.38	9.14	0.55	8.53	0.61	8.53	0.73	8.53
	0700	0.36	9.14	0.59	8.83	0.58	8.83	0.68	8.83
	1300	0.33	8.53	0.47	9.14	0.60	8.26	0.61	8.83
	1900	0.45	8.83	0.56	8.53	0.61	8.83	0.63	9.14
22	0100	0.35	9.14	0.53	8.26	0.62	8.83	0.60	9.14
	0700	0.34	8.83	0.49	8.83	0.58	9.14	0.60	9.14
	1300	0.30	9.14	0.41	8.53	0.52	9.48	0.57	8.83
	1900								
23	0100								
	0700								
	1300								
	1900								
24	0100								
	0700								
	1300	0.32	8.83	0.36	8.26	0.44	8.83	*	
	1900	0.34	8.83	0.39	8.26	0.49	8.53	*	
25	0100	0.26	9.48	0.34	9.48	0.39	8.53	*	
	0700	0.34	9.14	0.48	8.53	0.50	8.83	*	
	1300	0.42	3.71	0.50	8.53	0.54	8.83	*	
	1900	0.36	8.53	0.51	8.26	0.48	8.26	*	
26	0100	0.46	3.46	0.62	7.76	0.54	8.83	*	
	0700	0.35	8.53	0.49	8.26	0.47	8.83	*	
	1300	0.38	2.84	0.55	8.83	*		*	
	1900	0.38	8.53	0.54	7.76	*		*	
27	0100	0.32	8.53	0.50	8.53	*		*	
	0700	0.35	8.26	0.44	8.00	*		*	
	1300	0.32	4.83	0.47	7.76	*		*	
	1900	0.37	7.76	0.45	8.00	*		*	
28	0100	0.29	6.40	0.46	7.53	*		*	
	0700	0.29	6.09	0.37	7.53	*		*	
	1300								
	1900	0.30	6.92	0.41	7.53	*		0.62	6.56
29	0100	0.29	7.76	0.44	7.53	*		0.58	6.74
	0700	0.27	6.56	0.42	6.92	*		0.55	6.74
	1300	0.27	6.92	0.38	6.56	0.50	6.74	0.51	6.92
	1900	0.34	6.92	0.40	6.74	0.46	6.92	0.61	6.74
30	0100	0.29	6.56	0.39	6.74	0.45	6.56	0.63	6.92
	0700	0.22	14.22	0.30	8.53	0.36	8.26	0.44	6.74
	1300	0.23	14.22	0.29	8.53	0.40	8.00	*	
	1900	0.25	14.22	0.27	13.47	0.36	8.26	*	
	Mean	0.51	8.72	0.67	8.89	0.76	8.79	0.86	8.12
	Std dev	0.34	2.97	0.38	2.23	0.43	2.11	0.42	2.11

\* Electronic problems

(Sheet 2 of 2)



#### PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data  
Jun 1990

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
1	0100	Along Cross Result								14	S	
1	0700	Along Cross Result	27 0 27	N	165	16 9 18	N off	South	34	N	7 3 8	S on 183
1	1300	Along Cross Result									5 1 5	S on 171
1	1900	Along Cross Result									5 4 6	S on 199
2	0100	Along Cross Result									4 8 9	N on 277
2	0700	Along Cross Result	29 13 32	N off	140	36 11 37	S off	South	0		9 3 9	S on 178
2	1300	Along Cross Result									8 2 8	S on 174
2	1900	Along Cross Result									10 2 10	S on 171
3	0100	Along Cross Result									5 5 7	S on 205
3	0700	Along Cross Result	36 5 36	N on	139	38 11 40	N off	South	37	N	7 5 9	S on 196
3	1300	Along Cross Result									2 9 9	S on 237
3	1900	Along Cross Result									10 8 13	N on 301
4	0100	Along Cross Result									3 9 9	N on 268
4	0700	Along Cross Result	2 12 12	N off	152	47 0 47	N	South	41	N	5 7 9	S on 214
4	1300	Along Cross Result									4 5 6	S on 211
4	1900	Along Cross Result									10 4 11	S off 138
5	0100	Along Cross Result									10 7 12	S off 125
5	0700	Along Cross Result	27 4 27	S off	131	122 0 122	S	North	76	S	21 11 24	S off 132
5	1300	Along Cross Result									42 15 45	S off 140
5	1900	Along Cross Result									28 17 33	S off 129

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Jun 1990

Day	Time	Pier Measurements					Beach Measurements			Current Meter	
		Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		(500m Updrift)			0.9 km Offshore		
		Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Depth -5.6m (NGVD) ID #519	
6	0100	Along								12	S
		Cross								0	
		Result								12	160
6	0700	Along	23	N		41	N			7	S
		Cross	2	off	143	6	off	North	41	2	on
		Result	23	346		41	349			7	176
6	1300	Along								0	
		Cross								4	on
		Result								4	250
6	1900	Along								4	S
		Cross								5	on
		Result								6	211
7	0100	Along									
		Cross									
		Result									
7	0700	Along	15	N		44	N				
		Cross	13	off	134	20	off	South	47		
		Result	20	22		48	4				
7	1300	Along									
		Cross									
		Result									
7	1900	Along									
		Cross									
		Result									
8	0100	Along									
		Cross									
		Result									
8	0700	Along	27	N		21	N				
		Cross	16	on	131	3	off	South	18		
		Result	31	309		21	349				
8	1300	Along									
		Cross									
		Result									
8	1900	Along									
		Cross									
		Result									
9	0100	Along									
		Cross									
		Result									
9	0700	Along	17	N		7	N				
		Cross	15	off	128	11	off	South	8		
		Result	23	22		13	36				
9	1300	Along									
		Cross									
		Result									
9	1900	Along									
		Cross									
		Result									
10	0100	Along									
		Cross									
		Result									
10	0700	Along	5	S		0					
		Cross	5	off	125	10	off	North	3		S
		Result	7	115		10	70				
10	1300	Along									
		Cross									
		Result									
10	1900	Along									
		Cross									
		Result									

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Jun 1990

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
11	0100	-Along Cross Result										
11	0700	-Along Cross Result	76 11 77	S off 151	125	76 11 77	S off 151	North	46	S		
11	1300	-Along Cross Result										
11	1900	-Along Cross Result										
12	0100	-Along Cross Result										
12	0700	-Along Cross Result	47 21 51	S on 184	140	152 76 170	S on 187	North	107	S		
12	1300	-Along Cross Result										
12	1900	-Along Cross Result										
13	0100	-Along Cross Result										
13	0700	-Along Cross Result	61 9 62	S off 151	143	47 21 51	N off 4	South	30	N		
13	1300	-Along Cross Result										
13	1900	-Along Cross Result										
14	0100	-Along Cross Result										
14	0700	-Along Cross Result	1 6 6	N off 58	140	76 11 77	N off 349	South	8	N		
14	1300	-Along Cross Result										
14	1900	-Along Cross Result										
15	0100	-Along Cross Result										
15	0700	-Along Cross Result	38 6 39	N off 349	152	29 26 39	N on 298	South	56	N		
15	1300	-Along Cross Result										
15	1900	-Along Cross Result										

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Jun 1990

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)			Speed	Dir
			Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed		
16	0100	Along Cross Result									
16	0700	Along Cross Result	5 0 5	S  160	140	61 6 61	N on 334	South	46	N	
16	1300	Along Cross Result									
16	1900	Along Cross Result									
17	0100	Along Cross Result									
17	0700	Along Cross Result	30 6 31	S off 149	140	76 0 76	N  340	South	19	S	
17	1300	Along Cross Result									
17	1900	Along Cross Result									
18	0100	Along Cross Result									
18	0700	Along Cross Result	36 4 36	S on 166	140	55 42 69	N on 303	South	42	N	
18	1300	Along Cross Result									
18	1900	Along Cross Result									
19	0100	Along Cross Result									
19	0700	Along Cross Result	5 14 15	N off 52	140	28 12 30	N off 4	South	30	N	
19	1300	Along Cross Result									
19	1900	Along Cross Result									
20	0100	Along Cross Result									
20	0700	Along Cross Result	28 0 28	S  160	140	38 4 38	S on 166	North	26	S	
20	1300	Along Cross Result									
20	1900	Along Cross Result									

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Jun 1990

Day	Time	Pier Measurements					Beach Measurements			Current Meter	
		Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	(500m Updrift) Dye 12m offshore (surface)			0.9 km Offshore Depth -5.6m (NGVD) ID #519	Speed
		Speed	Dir	(m)	Speed	Dir	Location	Speed	Dir	Speed	Dir
21	0100-Along Cross Result										
21	0700-Along Cross Result	4 10 11	N off 49	128	51 8 51	N off 349	South	66	N		
21	1300-Along Cross Result										
21	1900-Along Cross Result										
22	0100-Along Cross Result										
22	0700-Along Cross Result	5 0 5	N  340	119	41 4 41	N on 334	South	48	N		
22	1300-Along Cross Result										
22	1900-Along Cross Result										
23	0100-Along Cross Result										
23	0700-Along Cross Result	18 16 24	N off 22	125	34 8 35	N off 354	South	22	N		
23	1300-Along Cross Result										
23	1900-Along Cross Result										
24	0100-Along Cross Result										
24	0700-Along Cross Result	2 1 2	N on 318	128	15 1 15	N on 337	South	5	S		
24	1300-Along Cross Result										
24	1900-Along Cross Result										
25	0100-Along Cross Result										
25	0700-Along Cross Result	18 1 18	S on 163	128	20 0 20	N  340	South	2	N		
25	1300-Along Cross Result										
25	1900-Along Cross Result										

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Concluded)  
Jun 1990

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed	Dir
26	0100	Along Cross Result										
26	0700	Along Cross Result	2 8 8	N on 262	128	68 10 68	N on 331	South	51	N		
26	1300	Along Cross Result										
26	1900	Along Cross Result										
27	0100	Along Cross Result										
27	0700	Along Cross Result	17 5 18	N off 357	140	27 1 27	N on 337	South	3	S		
27	1300	Along Cross Result										
27	1900	Along Cross Result										
28	0100	Along Cross Result										
28	0700	Along Cross Result	36 0 36	N  340	140	47 2 47	N off 343	South	58	N		
28	1300	Along Cross Result										
28	1900	Along Cross Result										
29	0100	Along Cross Result										
29	0700	Along Cross Result	20 20 29	N off 25	140	55 3 55	N off 343	South	33	N		
29	1300	Along Cross Result										
29	1900	Along Cross Result										
30	0100	Along Cross Result										
30	0700	Along Cross Result	2 10 10	N off 58	140	36 2 36	N on 337	South	11	N		
30	1300	Along Cross Result										
30	1900	Along Cross Result										

KEY = All speeds in cm/sec  
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## PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Jun 1990

Day	Time	Wave Approach Angle at Pier End deg from True N		Radar Wave Angle deg from True N	Width of Surf Zone.m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis.,m
1	0744	75			69	17.2	1.0204	4.3
2	0717	90			49	17.2	1.0205	3.7
3	0707	90	110		47	16.1	1.0234	4.3
4	0730	100			43	16.7	1.0234	4.3
5	0737	45		50	70	17.8	1.0230	3.7
6	0727	60			79	20.0	1.0184	4.6
7	0750	100			35	17.2	1.0232	4.3
8	0755	90			52	20.6	1.0220	6.1
9	0712	115			6	16.7	1.0235	5.2
10	0656	30			18	16.7	1.0236	3.7
11	0641	45	345	40	27	21.1	1.0210	
12	0700	30		40	76	21.7	1.0190	3.7
13	0700	65	5	70	294	21.1	1.0188	2.4
14	0700	80			244	21.1	1.0202	2.7
15	0653	75	90		88	20.6	1.0201	2.4
16	0705	85	50		61	20.6	1.0202	3.0
17	0737	90			69	21.1	1.0204	1.2
18	0641	80	55		61	22.2	1.0184	2.1
19	0700	95			64	20.6	1.0214	2.1
20	0800	95	25		70	21.1	1.0218	3.7
21	0723	100			52	22.2	1.0202	2.4
22	0714	95			32	23.9	1.0197	3.7
23	0725	100	10	inoperative	23	22.2	1.0206	3.7
24	0736	95		inoperative	24	21.1	1.0220	6.7
25	0700	95	15	inoperative	27	22.8	1.0212	5.5
26	0706	85	80	inoperative	30	23.3	1.0200	5.2
27	0740	105			38	23.3	1.0202	6.1
28	0719	100			43	23.9	1.0209	5.5
29	0703	105			38	18.9	1.0230	4.3
30	0646	100			30	16.7	1.0240	4.9

## PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

# FRF Tide Heights

Jun 1990

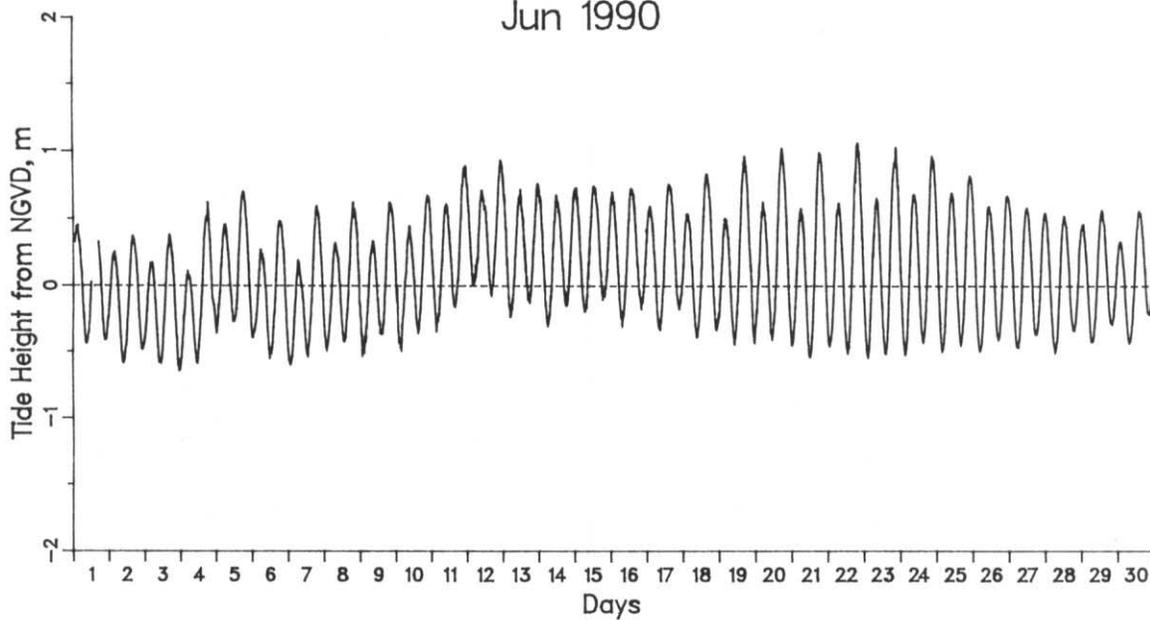


Figure 4. Water Level Time History

### Monthly Water Levels, m NGVD

Extreme Low = -0.65 on day 3 at 2224 EST  
Extreme High = 1.06 on day 22 at 1906 EST  
Monthly Mean = 0.12  
Mean Low = -0.39  
Mean High = 0.68  
Mean Range = 1.07

Table 6: Water Levels.m NGVD

		Jun 1990			
Mid-Cycle	Day Time	Low	High	Mean	Range
1	612				
1	1837				
2	703	-0.59	0.25	-0.16	0.84
2	1928	-0.48	0.37	-0.07	0.85
3	753	-0.59	0.17	-0.19	0.76
3	2018	-0.65	0.38	-0.15	1.02
4	843	-0.59	0.28	-0.18	0.87
4	2109	-0.36	0.62	0.10	0.98
5	934	-0.27	0.49	0.11	0.77
5	2159	-0.40	0.70	0.11	1.10
6	1024	-0.55	0.38	-0.10	0.93
6	2249	-0.60	0.48	-0.09	1.09
7	1115	-0.54	0.45	-0.11	0.98
7	2340	-0.49	0.59	0.02	1.09
8	1205	-0.43	0.50	0.01	0.93
9	30	-0.53	0.62	0.00	1.16
9	1255	-0.37	0.61	0.03	0.98
10	121	-0.50	0.62	0.06	1.12
10	1346	-0.36	0.62	0.10	0.98
11	211	-0.35	0.67	0.17	1.02
11	1436	-0.16	0.84	0.27	1.01
12	301	0.01	0.89	0.42	0.88
12	1527	-0.08	0.94	0.38	1.01
13	352	-0.24	0.92	0.29	1.16
13	1617	-0.13	0.76	0.30	0.89
14	442	-0.31	0.76	0.20	1.07
14	1707	-0.15	0.72	0.28	0.87
15	532	-0.20	0.74	0.27	0.94
15	1758	-0.10	0.74	0.32	0.84
16	623	-0.31	0.71	0.20	1.03
16	1848	-0.18	0.73	0.27	0.90
17	713	-0.34	0.72	0.16	1.05
17	1938	-0.18	0.76	0.27	0.93
18	804	-0.39	0.76	0.12	1.16
18	2029	-0.34	0.83	0.20	1.17
19	854	-0.45	0.85	0.13	1.30
19	2119	-0.44	0.96	0.23	1.40
20	944	-0.41	0.89	0.18	1.30
20	2210	-0.45	1.02	0.23	1.48
21	1035	-0.54	0.82	0.08	1.36
21	2300	-0.46	0.99	0.21	1.45
22	1125	-0.52	0.83	0.11	1.34
22	2350	-0.55	1.06	0.21	1.61
23	1216	-0.52	0.82	0.12	1.34
24	41	-0.52	1.03	0.20	1.55
24	1306	-0.43	0.80	0.17	1.23
25	131	-0.50	0.97	0.19	1.47
25	1356	-0.45	0.69	0.15	1.15
26	222	-0.50	0.82	0.13	1.32
26	1447	-0.41	0.59	0.11	1.01
27	312	-0.47	0.67	0.09	1.14
27	1537	-0.37	0.58	0.10	0.95
28	402	-0.51	0.55	0.01	1.06
28	1628	-0.34	0.52	0.08	0.87
29	453	-0.43	0.46	0.01	0.89
29	1718	-0.30	0.57	0.11	0.86
30	543	-0.44	0.36	-0.03	0.80
30	1808	-0.22	0.56	0.15	0.78

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in May and the two surveys in June on profile line 188, located 517 m south of the pier. The most significant change was a 50 m shoreward migration of the nearshore bar (100 - 200 m). Also visible is a small amount of accretion on the shoreward face (240 - 300 m) of the offshore bar.

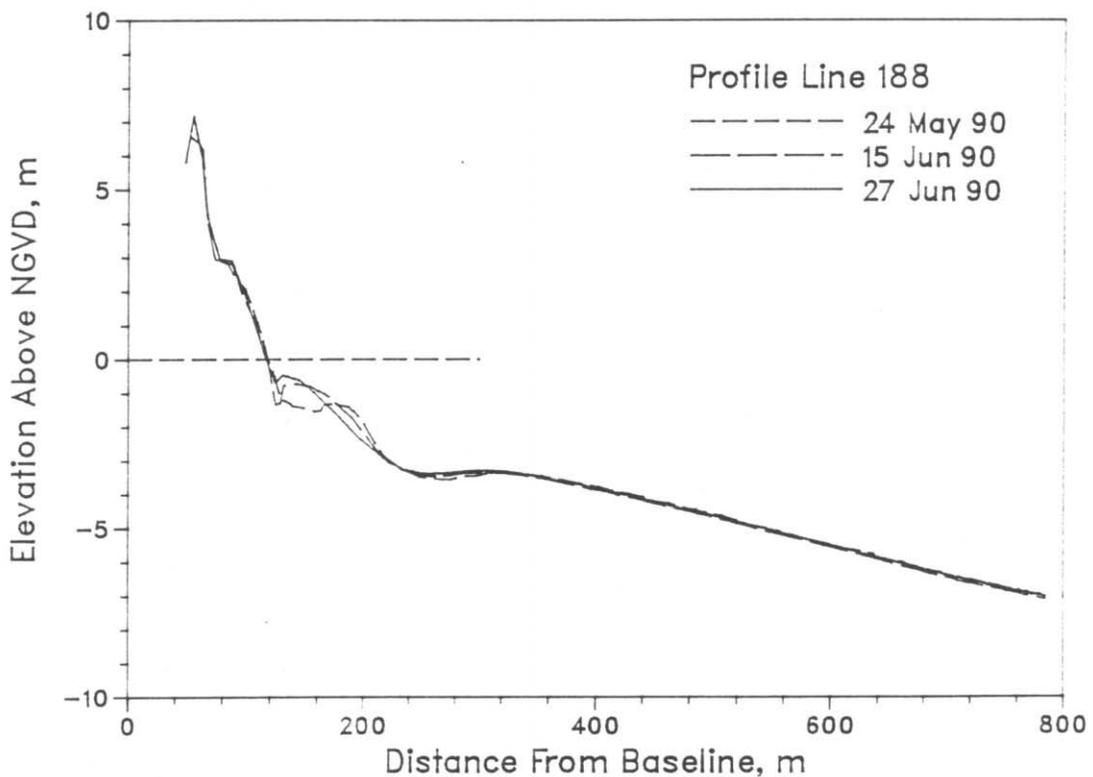


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1989. The accretion on the offshore bar is responsible for the slight change (260 - 300 m) to the envelope.

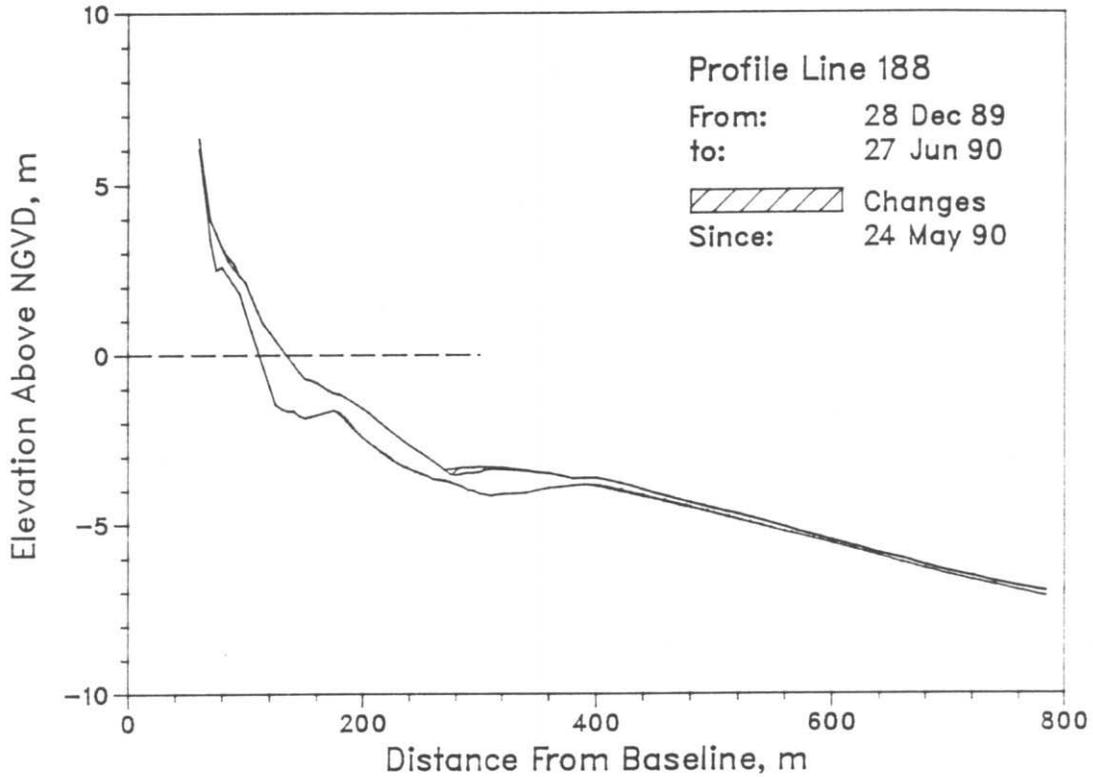


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 27 June. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

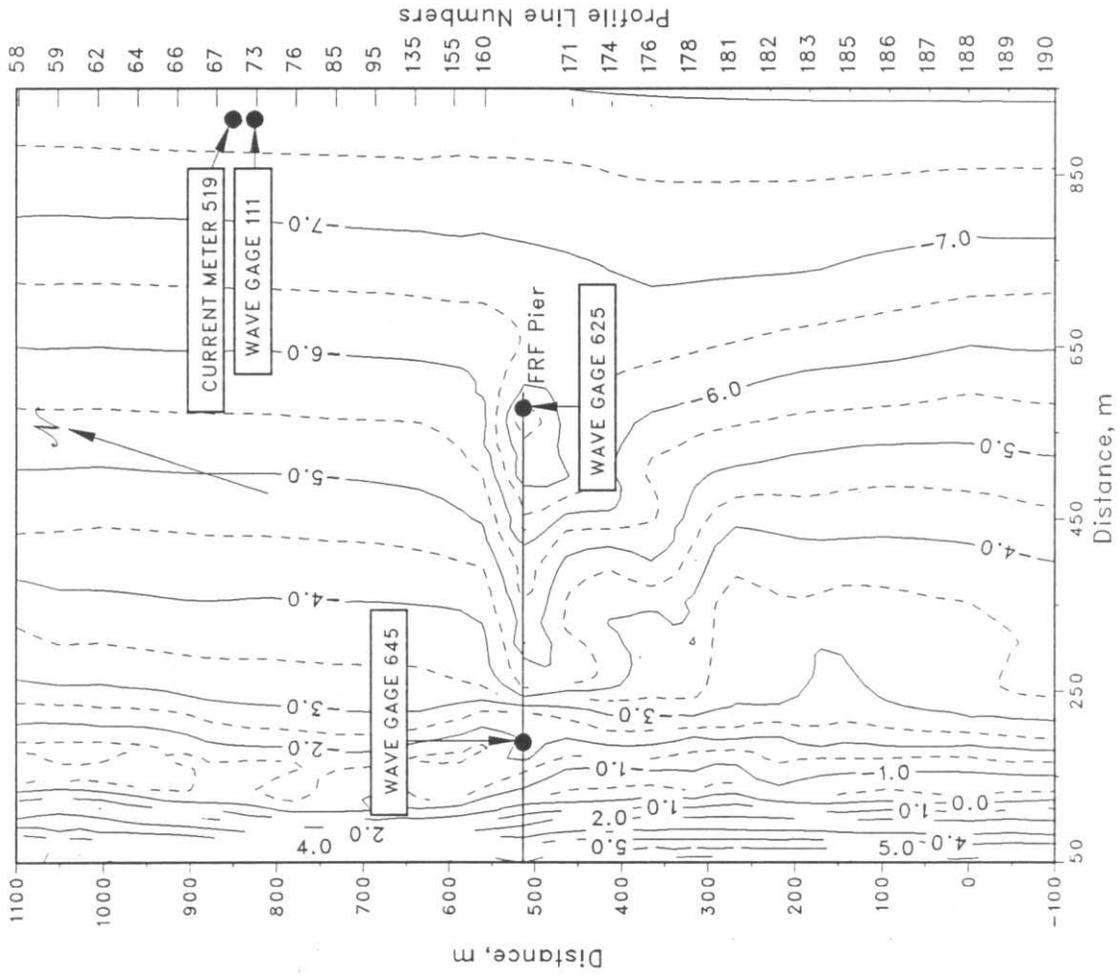
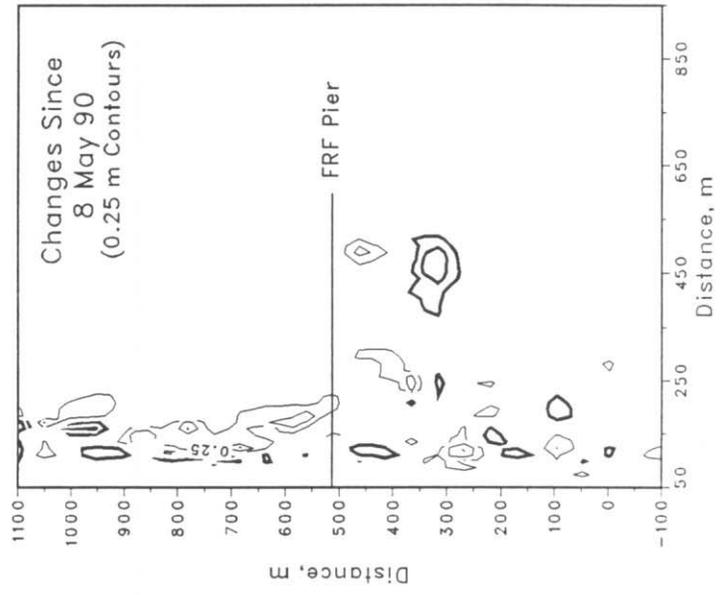
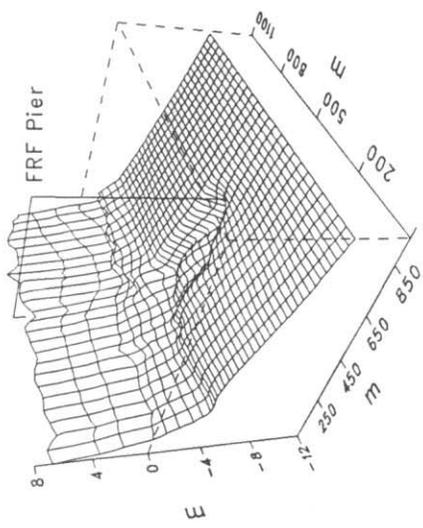


Figure 8. FRF bathymetry 27 Jun 90 depths relative to NGVD

## Distribution List

### Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
SAW	U.S. Naval Research Lab

### Colleges/Universities:

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East Carolina University	University of Akron
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Old Dominion University	University of North Carolina
Oregon State University	University of N. Colorado
Prince George's College	University of Rhode Island
Rutgers University	University of Virginia
Scripps Inst. of Oceanography	Va. Inst. of Marine Science
Southern Illinois University	

### Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
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